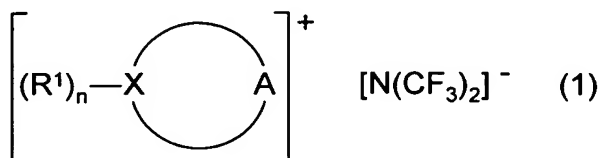


## Patent Claims

1. Salts of saturated, partially or fully unsaturated, heterocyclic cations having the bis(trifluoromethyl)imide anion,  $N(CF_3)_2^-$ , which have the general formula (1)



where

X = N, P, O or S

n = an integer selected from 0, 1 or 2 in such a way that X is saturated in accordance with its valency increased by 1,

A = a saturated, partially or fully unsaturated 3- to 8-membered hydrocarbon chain,  
in which all carbon atoms apart from one may be replaced by identical or different heteroatoms selected from N, P, O and S, where the carbon atoms of the hydrocarbon chain and the heteroatoms present therein are saturated by substituents  $R^2$  in accordance with their valency,

$R^1, R^2 =$  -H, with the proviso that there is no bond to the positively charged heteroatom,  
straight-chain or branched alkyl having 1-20 carbon atoms  
straight-chain or branched alkenyl having 2-20 carbon atoms and one or more double bonds  
straight-chain or branched alkynyl having 2-20 carbon atoms and one or more triple bonds  
saturated, partially or fully unsaturated cycloalkyl having 3-7 carbon atoms

halogen, in particular fluorine or chlorine, with the proviso that, for  
X = N, O, S, there is no halogen-heteroatom bond,  
-NO<sub>2</sub>, with the proviso that there is no bond to a positively  
charged heteroatom,  
5 -CN, with the proviso that there is no bond to a positively charged  
heteroatom,

where the R<sup>2</sup> and/or R<sup>1</sup> in different and/or identical position of the  
heterocyclic ring are in each case identical or different,

where the R<sup>2</sup> and/or R<sup>1</sup> may be connected to one another in pairs  
by a single or double bond,

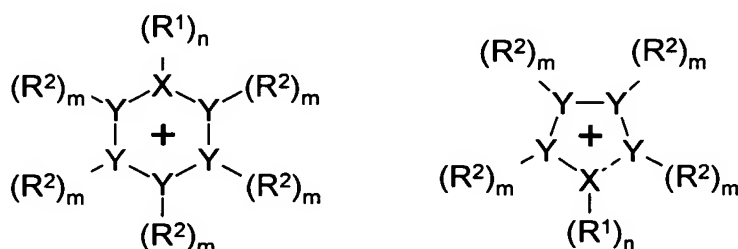
where one or more R<sup>2</sup> and/or R<sup>1</sup> may be partially or fully substi-  
tuted by halogens, in particular -F and/or -Cl, or partially by -CN  
or -NO<sub>2</sub>, with the proviso that not all R<sup>2</sup> and R<sup>1</sup> are fully halo-  
genated,

and where one or two carbon atoms of the R<sup>1</sup> and/or R<sup>2</sup> may be  
replaced by heteroatoms and/or atomic groups selected from the  
group -O-, -C(O)-, C(O)O-, -S-, -S(O)-, -SO<sub>2</sub>-, -SO<sub>2</sub>O-, -N=, -P=,  
-NH-, -PH-, -NR'- and -PR'- where R' = non-, partially or perfluori-  
nated C<sub>1</sub>- to C<sub>6</sub>-alkyl or -C<sub>6</sub>F<sub>5</sub>, where the α-position of the R<sup>1</sup> is  
not replaced for X = O, S.

- 25 2. Salts according to Claim 1, in which A is a 4-, 5- or 6-membered hydrocarbon chain.
3. Salts according to Claim 1 or 2, in which A is a hydrocarbon chain in which zero, one or two carbon atoms are replaced by heteroatoms selected from N, P, O and S.
- 30 4. Salts according to one of Claims 1 to 3, in which  
R<sup>1</sup>, R<sup>2</sup>, independently of one another, have the meaning  
-H, with the proviso that there is no bond to the positively charged  
heteroatom,

halogen, in particular fluorine, with the proviso that for  $X = N, O, S$ , there is no halogen-heteroatom bond,  
 straight-chain or branched alkyl having 1-6 carbon atoms, in particular  $-CH_3, -C_2H_5, -n-C_3H_7, -CH(CH_3)_2, -n-C_4H_9, -n-C_6H_{13},$   
 5 straight-chain or branched, partially or perfluorinated alkyl having 1-6 carbon atoms, in particular  $-CF_3, -C_2F_5, -C_4F_9.$

5. Salts according to one of Claims 1 to 4, in which the saturated, partially or fully unsaturated, heterocyclic cation is selected from the following group:



10 where

$X =$  N, P, O or S

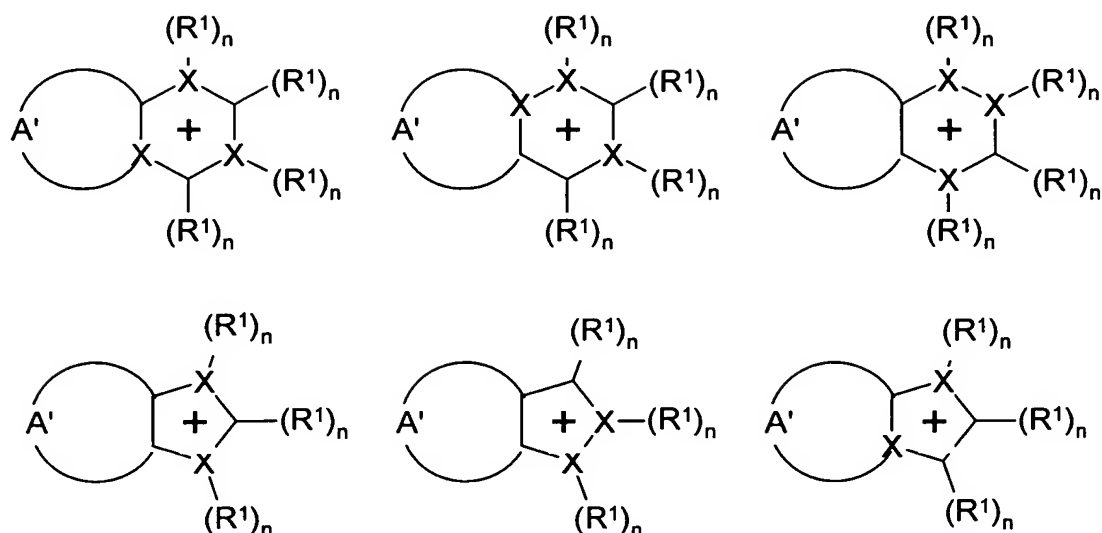
$Y =$  in each case, independently of one another, N, P, O, S or C, where at least one  $Y = C$

15  $n =$  0 for unsaturated  $X = O, S$   
 1 for saturated  $X = O, S$  or for unsaturated  $X = N, P$   
 2 for saturated  $X = N, P$

$m =$  0 for saturated  $Y = O, S$  or for unsaturated  $Y = N, P$   
 1 for saturated  $Y = N, P$  or for  $Y = sp^2-C$   
 2 for  $Y = sp^3-C$

20 where the radicals  $R^1, R^2$  are as defined in Claim 1.

6. Salts according to one of Claims 1 to 4, in which the saturated, partially or fully unsaturated, heterocyclic cation is selected from the following group:



where

X = in each case, independently of one another, N, P, O, S or C,  
 where at least one X = N, P, O or S

n = 0 for saturated X = O, S or for unsaturated X = N, P  
 1 for saturated X = N, P or for X = sp<sup>2</sup>-C  
 or for substitution on the sp<sup>2</sup> ring carbon atom  
 2 for X = sp<sup>3</sup>-C

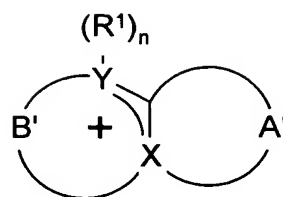
or for substitution on the sp<sup>3</sup> ring carbon atom

where n is increased by 1 for one X = N, P, O or S

A' = saturated, partially or fully unsaturated 2- to 7-membered hydro-  
 carbon chain,  
 where the carbon atoms of the hydrocarbon chain are saturated  
 by substituents R<sup>2</sup> in accordance with their valency

where the radicals R<sup>1</sup>, R<sup>2</sup> are as defined in Claim 1, with the proviso that the  
 substituents R<sup>1</sup> in the α-position to the positively charged heteroatom do not  
 have a methylene group directly adjacent to the heterocyclic ring.

7. Salts according to one of Claims 1 to 4, in which the saturated, partially or  
 fully unsaturated, heterocyclic cation has the following structure



where

X = N or P

Y = N, P, O or S

5            n =            0 for Y = O, S  
                                 1 for Y = N, P

A' = saturated, partially or fully unsaturated 2- to 7-membered hydrocarbon chain,

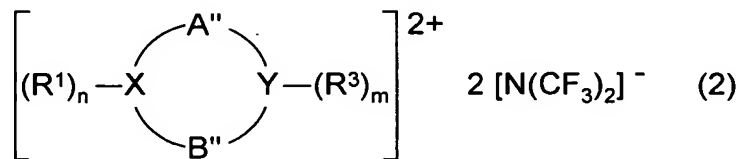
10 B' = saturated, partially or fully unsaturated 1- to 6-membered hydrocarbon chain,

where all carbon atoms of the hydrocarbon chains A' and B' apart from one may be replaced by identical or different heteroatoms selected from N, P, O and S

and where the carbon atoms of the hydrocarbon chains A' and B' are saturated by substituents R<sup>2</sup> in accordance with their valency

and where the radicals  $R^1, R^2$  are as defined in Claim 1.

8. Salts of saturated, partially or fully unsaturated, heterocyclic di-cations having the bis(trifluoromethyl)imide anion,  $N(CF_3)_2^-$ , which have the general formula (2)



where

X, Y = each, independently of one another, N, P, O or S

n, m = an integer selected from 0, 1 or 2 in such a way that X and Y  
5 are each saturated in accordance with their valency increased by 1,

A'', B'' = saturated, partially or fully unsaturated 0- to 4-membered hydro-  
carbon chain,  
10 in which the carbon atoms may be replaced by identical or different heteroatoms selected from N, P, O and S,  
where at least one carbon atom is present in the chains A'' and B'' together and  
where the carbon atoms of the hydrocarbon chains A'' and B''  
15 and the heteroatoms present therein are saturated by substituents R<sup>2</sup> in accordance with their valency,

R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> = -H, with the proviso that there is no bond to the positively  
charged heteroatom,  
20 straight-chain or branched alkyl having 1-20 carbon atoms  
straight-chain or branched alkenyl having 2-20 carbon atoms  
and one or more double bonds  
straight-chain or branched alkynyl having 2-20 carbon atoms  
and one or more triple bonds  
25 saturated, partially or fully unsaturated cycloalkyl having 3-7  
carbon atoms  
halogen, in particular fluorine or chlorine, with the proviso that,  
for X, = N, O, S, there is no halogen-heteroatom bond,  
-NO<sub>2</sub>, with the proviso that there is no bond to a positively  
30 charged heteroatom,  
-CN, with the proviso that there is no bond to a positively  
charged heteroatom,

where the R<sup>1</sup>, R<sup>2</sup> and/or R<sup>3</sup> in different and/or identical position  
35 of the heterocyclic ring are in each case identical or different,

where the  $R^1$ ,  $R^2$  and/or  $R^3$  may be connected to one another in pairs by a single or double bond,

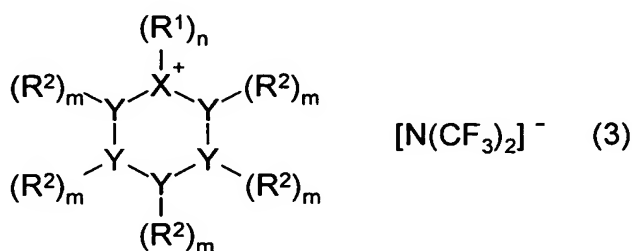
where one or more  $R^1$ ,  $R^2$  and/or  $R^3$  may be partially or fully substituted by halogens, in particular -F and/or -Cl, or partially by -CN or -NO<sub>2</sub>, with the proviso that that not all  $R^1$ ,  $R^2$  and  $R^3$  are fully halogenated,

and where one or two carbon atoms of the  $R^1$ ,  $R^2$  and/or  $R^3$  may be replaced by heteroatoms and/or atomic groups selected from the group -O-, -C(O)-, C(O)O-, -S-, -S(O)-, -SO<sub>2</sub>-, -SO<sub>2</sub>O-, -N=, -P=, -NH-, -PH-, -NR'- and -PR'- where R' = non-, partially or perfluorinated C<sub>1</sub>- to C<sub>6</sub>-alkyl or -C<sub>6</sub>F<sub>5</sub>, where the  $\alpha$ -positions of the  $R^1$  and of the  $R^3$  are not replaced for X = O, S or Y = O, S,

where the heterocyclic di-cation is a 4-, 5-, 6-, 7-, 8- or 9-membered ring.

9. Salts according to Claim 8, in which the heterocyclic di-cation is a 5-, 6- or 7-membered ring.

10. Salts of saturated, partially or fully unsaturated, heterocyclic cations having the bis(trifluoromethyl)imide anion,  $N(CF_3)_2^-$ , which have the general formula (3)



where

X, Y = each, independently of one another, N, P, O or S

n = an integer selected from 0, 1 or 2 in such a way that X is saturated in accordance with its valency increased by 1,

m = an integer selected from 0, 1 or 2 in such a way that Y is saturated in accordance with its valency,

R<sup>1</sup>, R<sup>2</sup> = -H, with the proviso that there is no bond to the positively charged heteroatom,  
straight-chain or branched alkyl having 1-20 carbon atoms  
straight-chain or branched alkenyl having 2-20 carbon atoms and one or more double bonds  
straight-chain or branched alkynyl having 2-20 carbon atoms and one or more triple bonds  
saturated, partially or fully unsaturated cycloalkyl having 3-7 carbon atoms  
halogen, in particular chlorine, with the proviso that, for X, = N, O, S, there is no halogen-heteroatom bond,  
-OR, with the proviso that the substituted heteroatom is not O or S,

where the R<sup>2</sup> and/or R<sup>1</sup> in different and/or identical position of the heterocyclic ring are in each case identical or different,

where the R<sup>2</sup> and/or R<sup>1</sup> may be connected to one another in pairs by a single or double bond,

where one or more R<sup>2</sup> and/or R<sup>1</sup> may be partially or fully substituted by halogens, in particular -F and/or -Cl, or partially by -CN or -NO<sub>2</sub>, with the proviso that not all R<sup>2</sup> and R<sup>1</sup> are fully halogenated,

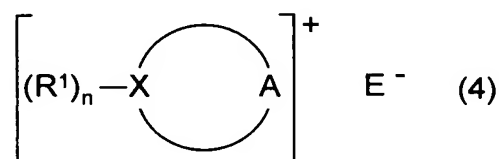
and where one or two carbon atoms of the R<sup>1</sup> and/or R<sup>2</sup> may be replaced by heteroatoms and/or atomic groups selected from the group -O-, -C(O)-, C(O)O-, -S-, -S(O)-, -SO<sub>2</sub>-, -SO<sub>2</sub>O-, -N=, -P=, -NH-, -PH-, -NR'- and -PR'- where R' = non-, partially or perfluorinated C<sub>1</sub>- to C<sub>6</sub>-alkyl or -C<sub>6</sub>F<sub>5</sub>, where the α-position of the R<sup>1</sup> is not replaced for X = O, S.

11. Process for the preparation of salts according to one of Claims 1 to 7, characterised in that an alkali metal fluoride of the general formula DF, where D selected from the group of the alkali metals, is reacted in a polar organic solvent with



where  $\text{R}^{\text{F}} = \text{F}$  or  $\text{C}_p\text{F}_{2p+1}$ , where  $p = 1 - 8$ ,

and a salt of the general formula (4)



where

10  $\text{E}^- =$   $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{BF}_4^-$ ,  $\text{ClO}_4^-$ ,  $\text{AsF}_6^-$ ,  $\text{SbF}_6^-$ ,  $\text{SbCl}_6^-$ ,  $\text{PF}_6^-$ ,  $\text{R}^{\text{F}}\text{SO}_3^-$ ,  $\text{FSO}_3^-$ ,  $(\text{R}^{\text{F}})_2\text{P}(\text{O})\text{O}^-$ ,  $\text{R}^{\text{F}}\text{P}(\text{O})_2\text{O}^-$ ,  $\text{RSO}_3^-$ ,  $\text{ROSO}_3^-$ ,  $\frac{1}{2}\text{SO}_3^{2-}$ ,  $\text{CN}^-$ ,  $\text{SCN}^-$ ,  $\text{R}^{\text{F}}\text{C}(\text{O})\text{O}^-$ ,  $\text{RC}(\text{O})\text{O}^-$ , 2,4-dinitrophenolate or 2,4,6-trinitrophenolate, where  $\text{R}^{\text{F}}$  is a perfluorinated  $\text{C}_1$  to  $\text{C}_8$ -alkyl group or perfluorinated aryl group and R is a  $\text{C}_1$  to  $\text{C}_8$ -alkyl group or aryl group

15  $\text{X} =$  N, P, O or S

$n =$  an integer selected from 0, 1 or 2 in such a way that X is saturated in accordance with its valency increased by 1,

20  $\text{A} =$  a saturated, partially or fully unsaturated 3- to 8-membered hydrocarbon chain,  
in which all carbon atoms apart from one may be replaced by identical or different heteroatoms selected from N, P, O and S,  
25 where the carbon atoms of the hydrocarbon chain and the heteroatoms present therein are saturated by substituents  $\text{R}^2$  in accordance with their valency,

$R^1, R^2 =$  -H, with the proviso that there is no bond to the positively charged heteroatom,  
 straight-chain or branched alkyl having 1-20 carbon atoms  
 5 straight-chain or branched alkenyl having 2-20 carbon atoms and one or more double bonds  
 straight-chain or branched alkynyl having 2-20 carbon atoms and one or more triple bonds  
 10 saturated, partially or fully unsaturated cycloalkyl having 3-7 carbon atoms  
 halogen, in particular fluorine or chlorine, with the proviso that, for  $X = N, O, S$ , there is no halogen-heteroatom bond,  
 -NO<sub>2</sub>, with the proviso that there is no bond to a positively charged heteroatom,  
 15 -CN, with the proviso that there is no bond to a positively charged heteroatom,

where the  $R^2$  and/or  $R^1$  in different and/or identical position of the heterocyclic ring are in each case identical or different,

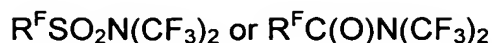
where the  $R^2$  and/or  $R^1$  may be connected to one another in pairs by a single or double bond,

where one or more  $R^2$  and/or  $R^1$  may be partially or fully substituted by halogens, in particular -F and/or -Cl, or partially by -CN or -NO<sub>2</sub>, with the proviso that not all  $R^2$  and  $R^1$  are fully halogenated,

and where one or two carbon atoms of the  $R^1$  and/or  $R^2$  may be replaced by heteroatoms and/or atomic groups selected from the group -O-, -C(O)-, C(O)O-, -S-, -S(O)-, -SO<sub>2</sub>-, -SO<sub>2</sub>O-, -N=, -P=, -NH-, -PH-, -NR'- and -PR'- where  $R' = \text{non-}, \text{partially or perfluorinated } C_1\text{- to } C_6\text{-alkyl or } -C_6F_5$ , where the  $\alpha$ -position of the  $R^1$  is not replaced for  $X = O, S$ .

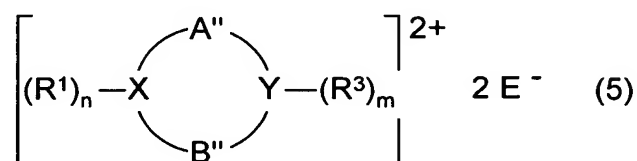
12. Process for the preparation of salts according to one of Claims 8 or 9, characterised in that an alkali metal fluoride of the general formula DF, where

D selected from the group of the alkali metals, is reacted in a polar organic solvent with



where  $R^F = F$  or  $C_p F_{2p+1}$ , where  $p = 1 - 8$ ,

5 and a salt of the general formula (5)



where

10  $E^- = F^-, Cl^-, Br^-, I^-, BF_4^-, ClO_4^-, AsF_6^-, SbF_6^-, SbCl_6^-, PF_6^-, R^F SO_3^-, FSO_3^-, (R^F)_2 P(O)O^-, R^F P(O)_2 O^-, RSO_3^-, ROSO_3^-, \frac{1}{2} SO_3^{2-}, CN^-, SCN^-, R^F C(O)O^-, RC(O)O^-, 2,4\text{-dinitrophenolate or } 2,4,6\text{-trinitrophenolate, where } R^F \text{ is a perfluorinated } C_1 \text{ to } C_8\text{-alkyl group or perfluorinated aryl group and } R \text{ is a } C_1 \text{ to } C_8\text{-alkyl group or aryl group}$

15  $X, Y =$  each, independently of one another, N, P, O or S

$n, m =$  an integer selected from 0, 1 or 2 in such a way that X, Y are each saturated in accordance with their valency increased by 1,

20  $A'', B'' =$  saturated, partially or fully unsaturated 0- to 4-membered hydrocarbon chain,  
in which the carbon atoms may be replaced by identical or different heteroatoms selected from N, P, O and S,  
where at least one carbon atom is present in the chains  $A''$  and  $B''$  together and  
25 where the carbon atoms of the hydrocarbon chains  $A''$  and  $B''$  and the heteroatoms present therein are saturated by substituents  $R^2$  in accordance with their valency,

$R^1, R^2, R^3 =$  -H, with the proviso that there is no bond to the positively charged heteroatom,

straight-chain or branched alkyl having 1-20 carbon atoms

straight-chain or branched alkenyl having 2-20 carbon atoms and one or more double bonds

straight-chain or branched alkynyl having 2-20 carbon atoms and one or more triple bonds

saturated, partially or fully unsaturated cycloalkyl having 3-7 carbon atoms

halogen, in particular fluorine or chlorine, with the proviso that, for X, = N, O, S, there is no halogen-heteroatom bond,

halogen, in particular fluorine or chlorine, with the proviso that there is no halogen-heteroatom bond,

-NO<sub>2</sub>, with the proviso that there is no bond to a positively charged heteroatom,

-CN, with the proviso that there is no bond to a positively charged heteroatom,

where the  $R^1, R^2$  and/or  $R^3$  in different and/or identical position of the heterocyclic ring are in each case identical or different,

where the  $R^1, R^2$  and/or  $R^3$  may be connected to one another in pairs by a single or double bond,

where one or more  $R^1, R^2$  and/or  $R^3$  may be partially or fully substituted by halogens, in particular -F and/or -Cl, or partially by -CN or -NO<sub>2</sub>, with the proviso that not all  $R^1, R^2$  and  $R^3$  are fully halogenated,

and where one or two carbon atoms of the  $R^1, R^2$  and/or  $R^3$  may be replaced by heteroatoms and/or atomic groups selected from the group -O-, -C(O)-, C(O)O-, -S-, -S(O)-, -SO<sub>2</sub>-, -SO<sub>2</sub>O-, -N=, -P=, -NH-, -PH-, -NR'- and -PR'- where R' = non-, partially or perfluorinated C<sub>1</sub>- to C<sub>6</sub>-alkyl or -C<sub>6</sub>F<sub>5</sub>, where the  $\alpha$ -position of the  $R^1$  is not replaced for X = O, S,

where the heterocyclic di-cation is a 4-, 5-, 6-, 7-, 8- or 9-membered ring.

13. Process according to Claim 11 or 12,  
characterised in that the alkali metal fluoride employed is KF or RbF.
- 5 14. Process according to one of Claims 11 to 13,  
characterised in that the reaction takes place at temperatures  
between -40°C and 80°C, in particular at 0°C to 40°C.
15. Process according to one of Claims 11 to 14,  
characterised in that the reaction takes place in a polar organic  
10 solvent selected from the group acetonitrile, dimethoxyethane, dimethylform-  
amide and propionitrile.
16. Process according to one of Claims 11 to 15,  
characterised in that the reaction is carried out as a one-pot reac-  
tion.
- 15 17. Process according to one of Claims 11 to 16,  
characterised in that the reaction for  $E^- = F^-$  is carried out without  
added alkali metal fluoride DF.
18. Process according to one of Claims 11 to 17,  
characterised in that the starting materials for the reaction are  
20 employed in approximately equimolar ratio to one another.
19. Use of a salt according to one of Claims 1 to 10 as ionic liquid.
20. Use of a salt according to one of Claims 1 to 10 as non-aqueous electrolyte.
21. Use of a salt according to one of Claims 1 to 10 as reagent for the introduc-  
tion of  $N(CF_3)_2$  groups.
- 25 22. Use of a salt according to one of Claims 1 to 10 as phase-transfer catalyst.

23. Use of a salt according to one of Claims 1 to 10 as intermediate for the synthesis of liquid-crystal compounds or active ingredients, in particular for medicaments or crop-protection agents.